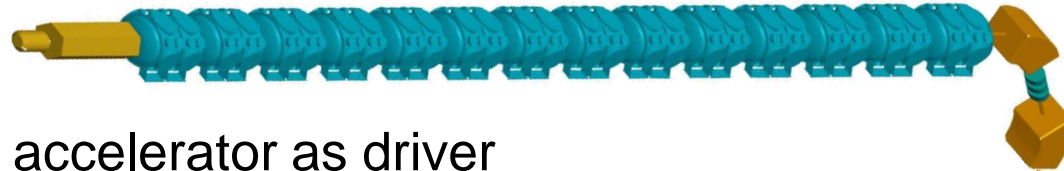


Progress in ISOL@MYRRHA project at SCK•CEN

Lucia Popescu
SCK•CEN
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- MYRRHA
- ISOL@MYRRHA
- Status of the project
- Plans
- Conclusions



- High power proton accelerator as driver

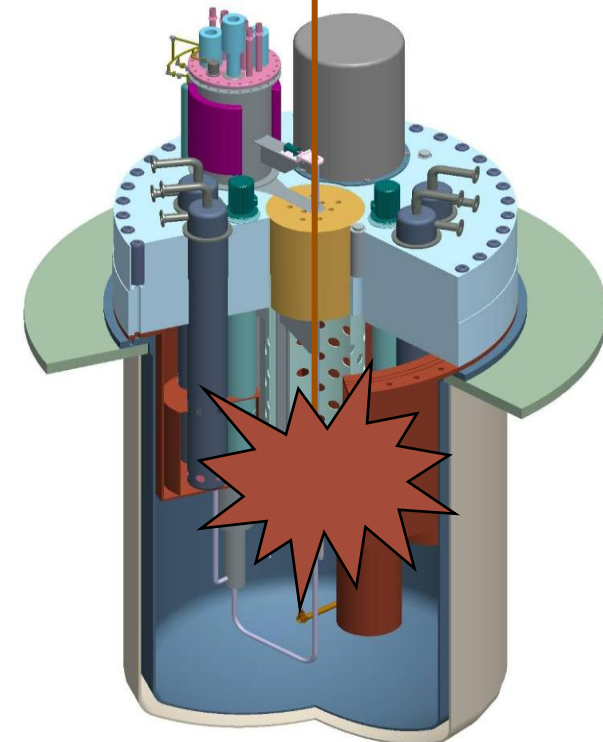
- High reliability
- Design values
 - $I = 4 \text{ mA}$
 - $E = 600 \text{ MeV}$

- Spallation target (LBE)

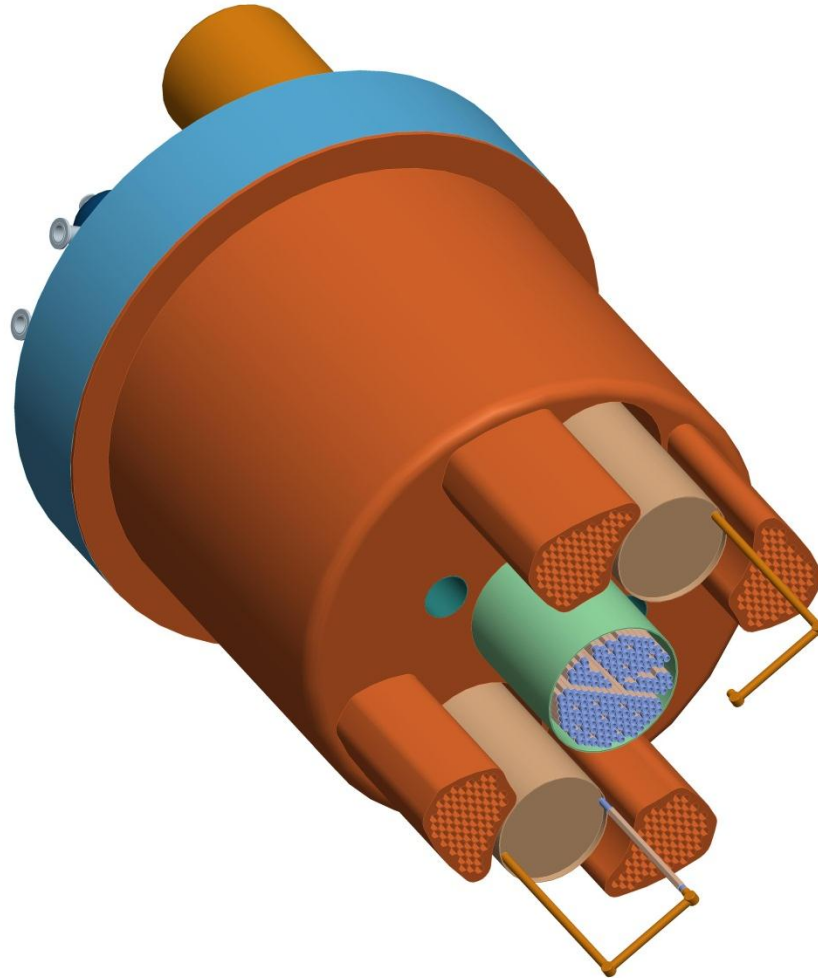


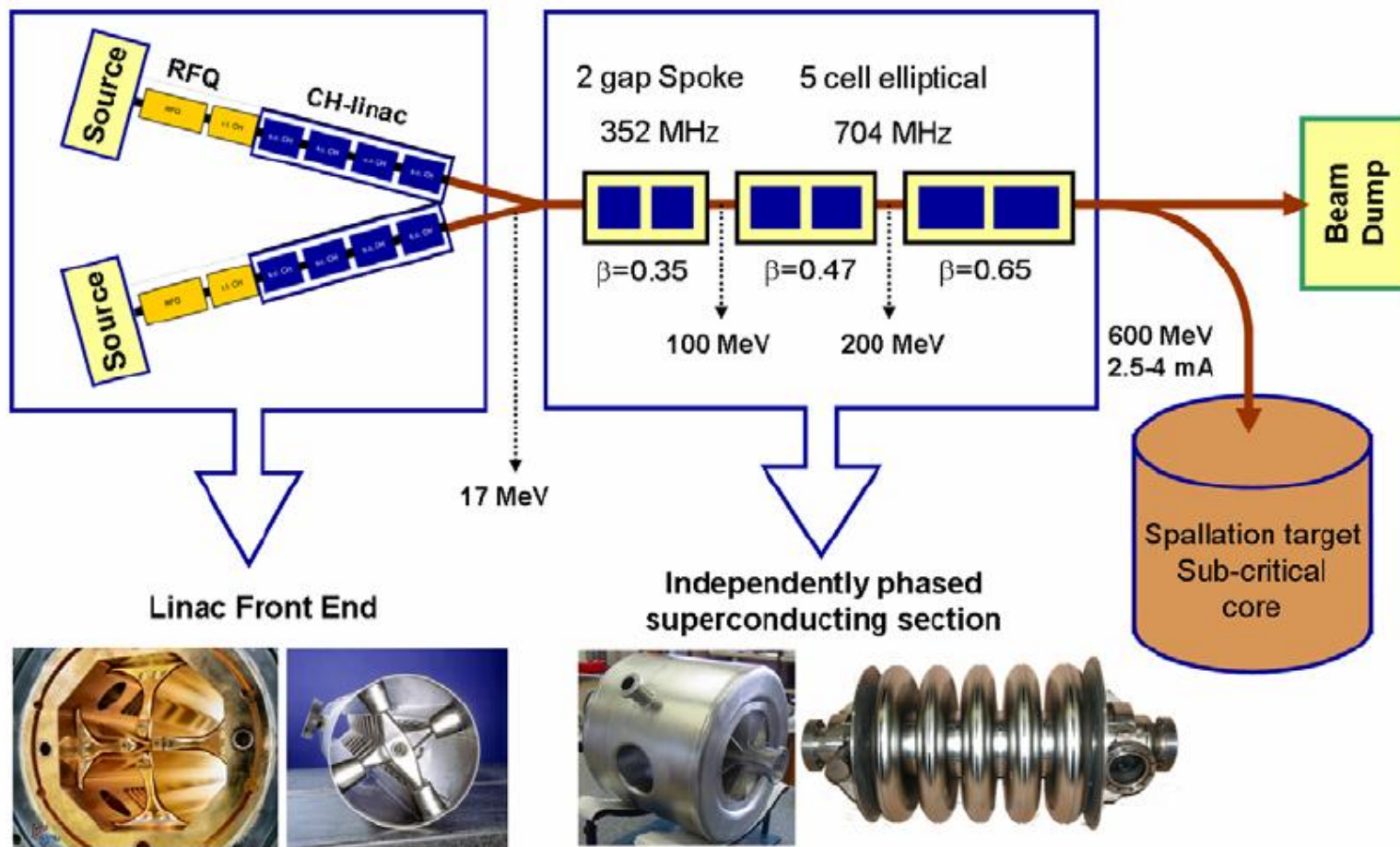
- Subcritical reactor

- High power density MOX core
- Liquid metal cooled
- High flexibility



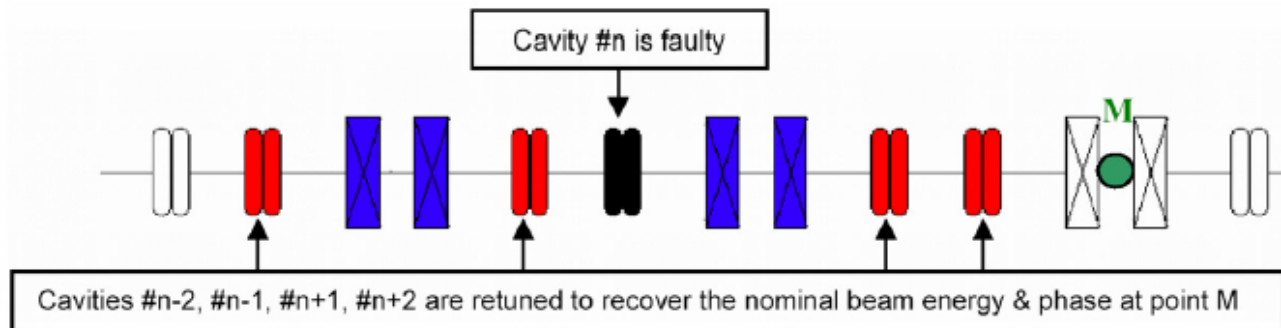
- Inner vessel
- Cover
- Core structure
- Spallation window
- Heat exchangers
- Pumps
- Diaphragm
- Fuel manipulators
- Guard vessel
- Fuel storage**





Fault Tolerance

Dynamic Compensation of RF Cavity Faults



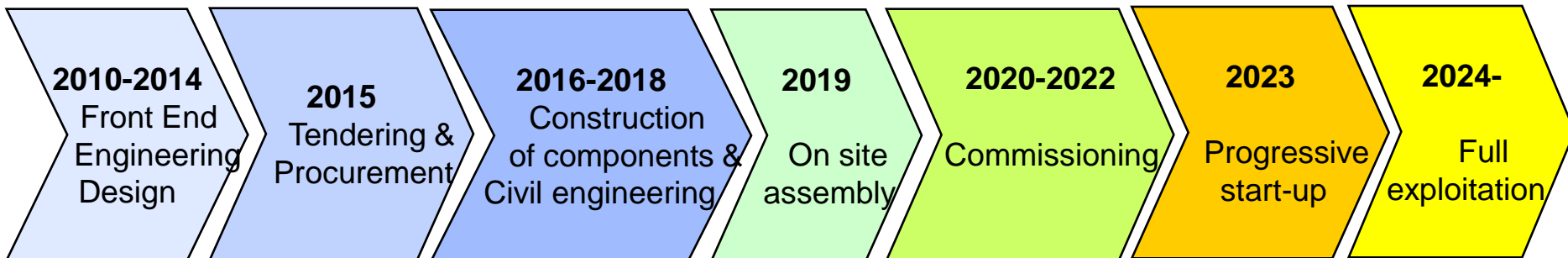
- Detection of an RF fault
- Change RF phase in neighbouring cavities
- Increase RF field in neighbouring cavities

Increase of 25% field level
→ 50% power margin required

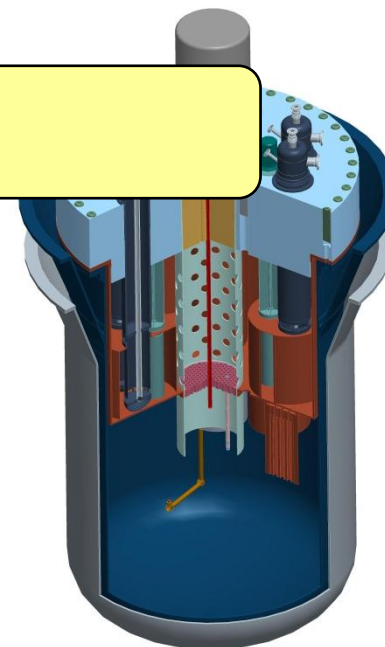
within < 3 sec

- **Sustainable fission energy:** demonstrate the physics and technology of an Accelerator Driven System (ADS) for transmuting long-lived radioactive waste
- **Sustainable energy:** development of fast spectrum reactor and fusion technology
- **Enabling technologies for renewable energies:** production of neutron irradiated silicon
- **Health care:** production of radioisotopes for nuclear medicine
- **Science:** fundamental research for the generation of new expertise in various fields.

Project schedule



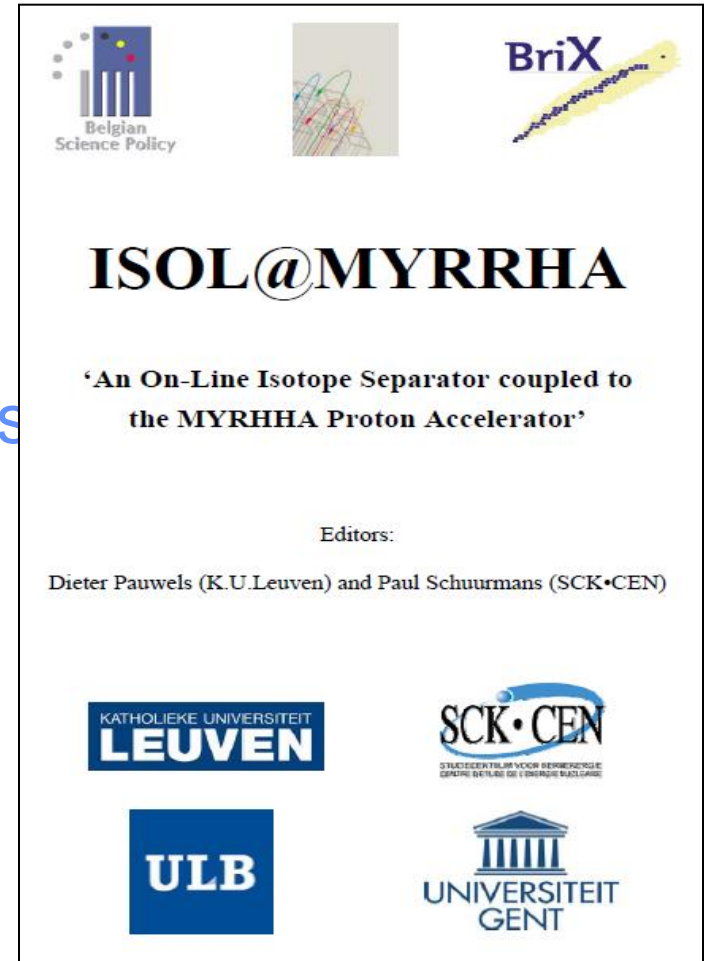
The project MYRRHA
on the 2010 ESFRI roadmap (Nov. 2010)

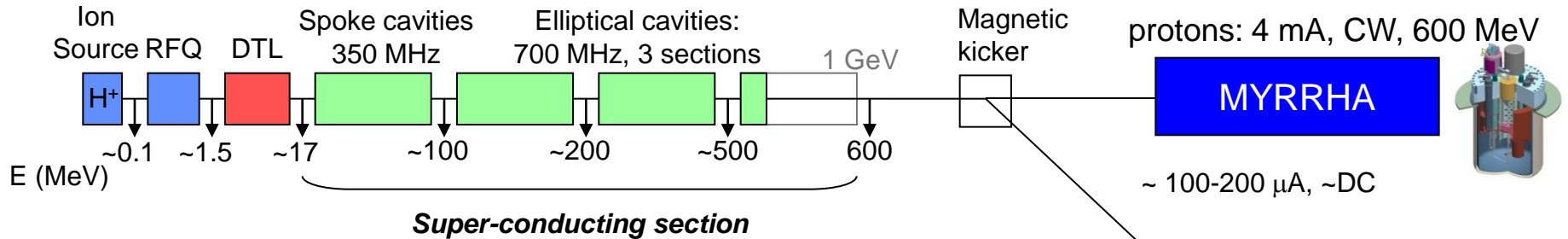


- **Pre-study** initiated in collaboration with KU Leuven, within the framework of the BriX network project

Fundamental Nuclear Physics

- April 6-9, 2008 - Workshop: "Nuclear physics research at the MYRRHA accelerator"

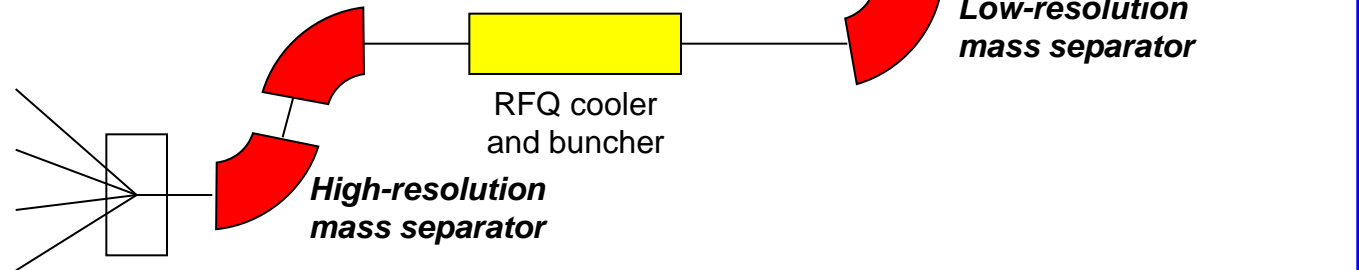




ISOL@MYRRHA

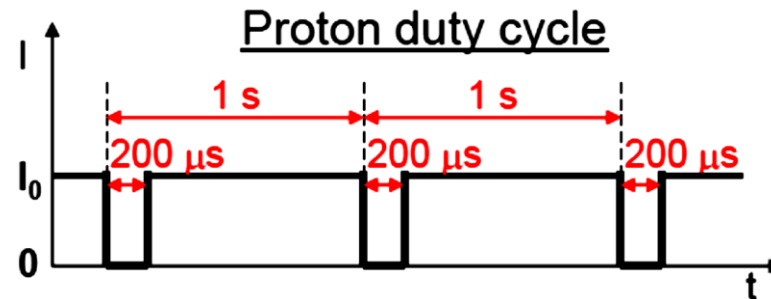
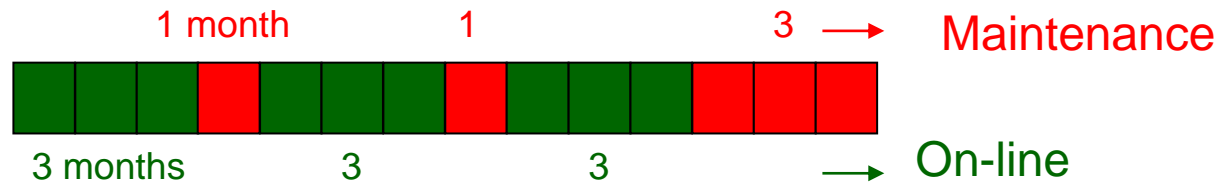
Pure and intense RIB offering unique opportunities for:

- **Fundamental interactions**
- **Solid-state physics**
- **Nuclear physics**
- **Atomic physics**
- **Radio-pharmaceuticals**



Slide from P. Van Duppen

- Interplay with the MYRRHA cycle:



- Use ~5% of each beam-pulse (=> CW beam)

ISOL@MYRRHA - Facility Characteristics

- based on proven technology (largely based on experience at ISOLDE and TRIUMF)
- can deliver:
 - pure RIB: selective ionization, chemistry, $M/DM > 10.000$
 - intense RIB (x100 compared to the present ISOLDE 'standard' RIB)
 - RIB of good ion optical quality
 - optimal experimental conditions/layout/support
 - **very long beam times** => unique possibilities for experiments that:
 - need very high statistics
 - involve many time consuming systematic measurements
 - hunt for very rare events
 - have an inherent limited detection efficiency
- research in the field of fundamental interaction studies, nuclear physics, atomic physics, condensed matter research, life science,...
- complementary to ISOL and In-Flight facilities: HIE-ISOLDE, SPIRAL2, TRIUMF, ORNL, EURISOL, FAIR, RIB factory, FRIB....
- Long term options:
 - 1-GeV proton beam
 - post-acceleration of the RIB to 10 MeV/u

- ISOL@MYRRHA is an integral part of the MYRRHA project
 - Delivery of the proton beam by MYRRHA
- Beam deflector, target-ion-source, mass separators, RFQ and buncher
 - Developed within the ISOL@MYRRHA consortium
 - SCK•CEN will play a leading role in ISOL@MYRRHA consortium
- Physics experiments (from focal plane of the separator)
 - To be run by users
 - Support by ISOL@MYRRHA in house group at SCK•CEN

• Workplan – roadmap (close contact between possible users and the MYRRHA team):

- ✓ ➤ **Approval and initial funding of the MYRRHA project**
- ✓ ➤ Preliminary report (IAP)
 - physics cases : look what will (is planned to be) done by 2020.
 - technical specifications from the users point of view
 - budgetplan/estimate
- Establishing a users group (including users outside of nuclear physics)
- Gathering ISOL expertise at SCK•CEN
- Operational model
- Time line

• Further applications for the full 4 mA beam (neutron factory)?

P. Schuurmans
IAP-day 2009

Research subjects:

- Cross section measurement of (n,f) reaction on Cm isotopes (*wp6 – current IAP phase*)
- Shape coexistence measurements in even-even neutron-deficient Polonium isotopes by Coulomb excitation using REX-ISOLDE and the Ge MINIBALL array (*PhD N. Kesteloot - in collaboration with KUL*)
- β -decay studies of neutron rich $^{61-70}\text{Mn}$ isotopes (*collaboration with KUL*)
- Experimental investigation of asymmetric fission in proton-rich nuclei around $Z=82$ (*new PhD position - in collaboration with KUL*)
- ISOL@MYRRHA – technical design (*next IAP phase ?*)
 - ...
 - ...
 - ...
- Other physics cases @ ISOLDE / SPIRAL2 / GSI

2011

Conceptual Design

2011/2012

Funding application
(BELSPO/FWO/FP7)

Technical Design Study for intense radioactive ion beams at ISOL@MYRRHA
on the NuPECC long range plan 2010 (Dec. 2010)

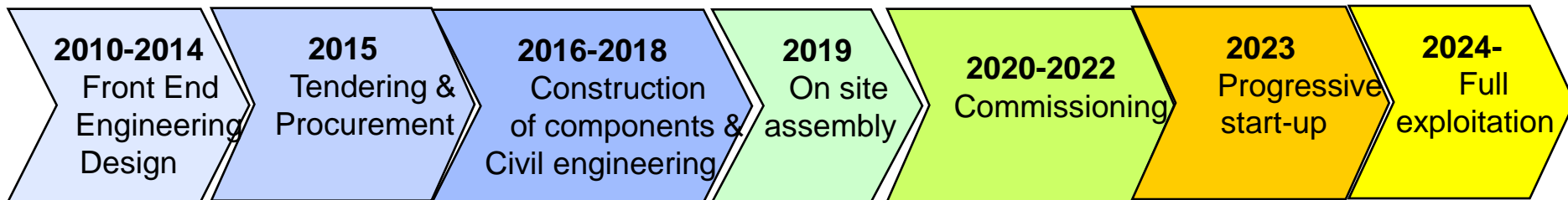
2012-2015

Detailed Technical Design

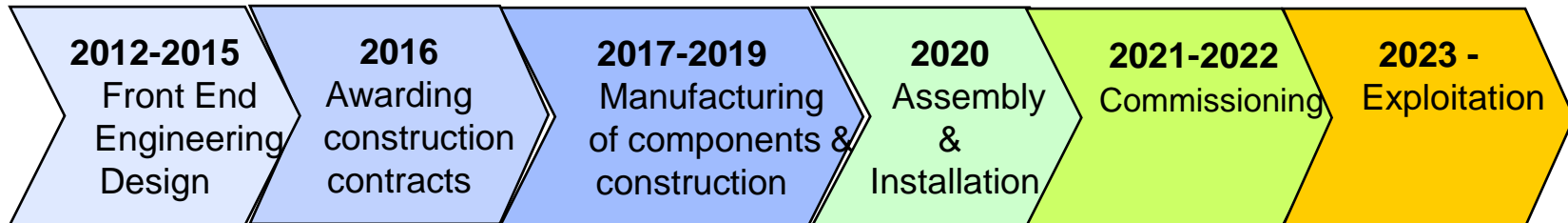
Technical Design

- Task1: Beam Deflector
- Task2: High-Power Target Ion Source
- Task3: Beam preparation: RFQ Cooler and Buncher
- Task4: Mass Separators
- Task5: Safety and Radioprotection

MYRRHA



ISOL@MYRRHA



Some (close) milestones:

- Build the Users Group (from 2011)
- Publish the Consortium Model (~2012)
- Build Consortium Group (~ 2015)

- MYRRHA – ADS project at SCK•CEN, approved by Belgian Government in March, 2010
- ISOL@MYRRHA – production of RIBs by coupling an ISOL facility to the MYRRHA proton accelerator
 - Key property: intense en pure RIB for experiments needing long beam times
 - Complementary and unique research opportunities in the fields of fundamental interaction, nuclear physics, atomic physics, condensed matter, life science,...
- Facilities developed in parallel
- Two different consortia (SCK•CEN leading role)
- Expected full exploitation: 2023

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SCK•CEN

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Centre d'Etude de l'Energie Nucléaire

Stichting van Openbaar Nut
Fondation d'Utilité Publique
Foundation of Public Utility

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